

Remarks

Reconsideration of this Application is respectfully requested.

Upon entry of the foregoing amendment, claims 1-47 are pending in the application, with claims 1, 20 and 29 being the independent claims. Claims 1, 6, 7, 27, 29, 31, 34, 35, 40 and 42 are sought to be amended. These changes are believed to introduce no new matter, and their entry is respectfully requested.

Based on the above amendment and the following remarks, Applicants respectfully request that the Examiner reconsider all outstanding objections and rejections and that they be withdrawn.

Rejections under 35 U.S.C. § 103

The Examiner has maintained the rejection of claims 1-10, 12, 13, 15, 16, 18, 20-27, 29-38, 40-43, 45 and 47 under 35 U.S.C. § 103(a) as being unpatentable over Marcellin *et al.*, "A Trellis-Search 16 KBit/Sec Speech Coder with Low Delay," ADVANCES IN SPEECH CODING, dated March 5, 1992 ("Marcellin") in view of Watts *et al.*, "A Vector ADPCM Analysis-By-Synthesis Configuration for 16 kbit/s Speech Coding," IEEE GLOBAL TELECOMMUNICATIONS CONFERENCE & EXHIBITION: "COMMUNICATIONS FOR THE INFORMATION AGE," 1988 ("Watts").

Based on the following remarks, Applicant respectfully traverses.

Rejection of Independent Claims 1 and 29

Independent claims 1 and 29 each generally relate to a novel way of performing vector quantization in a Noise Feedback Coding (NFC) system. In particular, independent claim 1 is directed to a method in an NFC system of efficiently searching N predetermined Vector Quantization (VQ) codevectors for a preferred one of the N VQ codevectors to be used in coding a speech or audio signal. The method of claim 1, as presently amended, includes the steps of:

- (a) predicting the speech signal to derive a residual signal;
- (b) deriving a ZERO-INPUT response error vector common to each of the N VQ codevectors, wherein the ZERO-INPUT response error vector is a component of a quantization error vector;
- (c) deriving N ZERO-STATE response error vectors each based on a corresponding one of the N VQ codevectors, wherein each of the N ZERO-STATE response error vectors is a component of a quantization error vector; and
- (d) selecting the preferred one of the N VQ codevectors as the VQ output vector corresponding to the residual signal based on the ZERO-INPUT response error vector and the N ZERO-STATE response error vectors.

Independent claim 29 is directed to an NFC system for fast searching N VQ codevectors stored in a VQ codebook for a preferred one of the N VQ codevectors to be used for coding a speech or audio signal. The NFC system of claim 29, as presently amended, includes:

- predicting logic adapted to predict the speech signal to derive a residual signal;
- a ZERO-INPUT filter structure adapted to derive a ZERO-INPUT response error vector common to each of the N VQ codevectors in the VQ codebook, wherein the ZERO-INPUT response error vector is a component of a quantization error vector;

a ZERO-STATE filter structure adapted to derive N ZERO-STATE response error vectors each based on a corresponding one of the N VQ codevectors in the VQ codebook, wherein each of the N ZERO-STATE response error vectors is a component of a quantization error vector; and

a selector adapted to select the preferred one of the N VQ codevectors as a VQ output vector corresponding to the residual signal based on the ZERO-INPUT response error vector and the N ZERO-STATE response error vectors.

The Examiner has rejected each of independent claims 1 and 29 as obvious based on the combination of Marcellin and Watts. In order to establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art at the time of the invention, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim elements. See MPEP §2143 (Rev. 2, May 2004). As will be described in more detail below, the Examiner's obviousness rejections of claims 1 and 29 are improper because (1) one of ordinary skill in the art would not have been motivated to combine the teachings of Marcellin and Watts; and (2) the combination of Marcellin and Watts fails to teach or suggest all of the elements of claims 1 and 29.

One of Ordinary Skill in the Art Would Not Have Been Motivated to Combine the Teachings of Marcellin and Watts

Marcellin discloses a Noise Feedback Coding (NFC) structure that uses Trellis Coded Quantization (TCQ) to quantize a prediction residual. Watts is directed to an Adaptive Differential Pulse Code Modulation (ADPCM) coding structure that performs a Vector Quantizer (VQ) codebook search to code an input speech signal. In Watts, vectors representing predicted speech (denoted \hat{x}_n) and reconstructed speech (denoted

y_n) are decomposed into zero-input response and zero-state response components as illustrated by Watt's equations (6)-(9). The decomposition simplifies the complexity in calculating a reconstruction error associated with a given codevector in a VQ codebook. In Watts, "reconstruction error" is defined as the difference between input speech (denoted x_n) and reconstructed speech y_n .

The Examiner states the one of ordinary skill in the art would have been motivated to combine the teachings of Marcellin and Watts because "the use of ZERO-INPUT and ZERO-STATE response/vectors as taught by Watts et al. . . . would have decreased the complexity of the system [of Marcellin] while maintaining the accuracy." However, this statement ignores several important differences between Marcellin and Watts, which will be explained below.

In the first place, Marcellin teaches away from the use of vector quantization in a speech coder, advocating the use of a very different quantization scheme entitled Trellis coded quantization (TCQ) as an alternative to vector quantization. As stated in Marcellin:

The means squared error (MSE) performance of TCQ is excellent. For encoding the memoryless uniform source, TCQ achieves a MSE within 0.21 dB of the distortion-rate function at all positive integral rates. This performance is better than that promised by the best lattices known in up to 24 dimensions [8]. ***In fact, evaluation of the asymptotic quantizer bound [9] indicates that no vector quantizer of dimension less than 69 can exceed the performance of TCQ for encoding the memoryless uniform source.***

See Marcellin, p. 47, second paragraph (emphasis added). Because Marcellin teaches away from performing vector quantization, one of ordinary skill in the art at the time of the invention would not have been motivated to combine Watts, which describes a vector

quantization scheme, with Marcellin, which advocates against the use of a vector quantization scheme.¹

Secondly, the coding structures taught by Marcellin and Watts are very different and thus one of ordinary skill in the art at the time of the invention would not have been motivated to combine them. Marcellin teaches a conventional Noise Feedback Coding (NFC) structure. The structure disclosed by Watts, on the other hand, is not a Noise Feedback Coding structure as that term is used in Marcellin and in the present application. This is because the speech coder in Watts does not generate a difference signal between a quantizer input and output, pass this value through a filter, and then add the filtered output to a prediction residual to form the quantizer input signal. As set forth in the specification of the present application:

In noise feedback coding, the difference signal between the quantizer input and output is passed through a filter, whose output is then added to the prediction residual to form the quantizer input signal. By carefully choosing the filter in the noise feedback path (called the *noise feedback filter*), the spectrum of the overall coding noise can be shaped to make the coding noise less audible to human ears.

See Specification at paragraph [0007]. The speech coder in Watts is shown as including a "noise feedback filter" (*see* Watts, Figure 1(b)); in actuality, however, this filter is a feed-forward filter and the "noise" referred to is not quantization noise.

The differences between the structures described in Marcellin and Watts are further manifested in the fact that the structure described in Watts is uniquely designed to

¹ In the Final Office Action, the Examiner acknowledges this shortcoming of Marcellin but nevertheless states that "Marcellin and Watts are related because the trellis is a well-known structure in the speech processing art that comprises multiple vectors." *See* Final Office Action at page 3. However, even if what the Examiner asserts is true—namely, that a trellis structure can encompass multiple vectors—that does not convert a TCQ quantizer into a vector quantizer; nor does it change the fact that Marcellin advocates against the use of vector quantization.

calculate a "reconstruction error" associated with a coder and to select a VQ codevector that minimizes this error. As noted above, Watts defines the "reconstruction error" as the difference between input speech x_n and reconstructed speech y_n . In contrast, Marcellin does not describe a structure that calculates a reconstruction error, let alone one that implements a quantization scheme to minimize it. Thus, contrary to the assertion of the Examiner, the teaching of Watts to decompose vectors representing predicted speech \hat{x}_n and reconstructed speech y_n into zero-input response and zero-state response components to simplify the calculation of the reconstruction error is not applicable to Marcellin. Moreover, given the fundamental difference between the coding structures described in Marcellin and Watts, it is not at all apparent how one could modify the structure of Marcellin to incorporate the features of Watts directed to calculating and minimizing reconstruction error.

**The Combination of Marcellin and Watts Fails to Teach or Suggest
All of the Limitation of Claims 1 and 29**

In addition to the foregoing, the Examiner has also failed to meet his burden in establishing a prima facie case of obviousness of independent claims 1 and 29 because the combination of Marcellin and Watts fails to teach or suggest each and every limitation of those claims.

As noted above, Marcellin is directed to a NFC structure that uses Trellis Coded Quantization (TCQ) to quantize a prediction residual. The Examiner contends that Marcellin teaches "processing steps that are functionally equivalent to the presently claimed invention." *See* Final Office Action at page 3. However, Marcellin teaches virtually none of the recited elements of independent claims 1 and 29. This is not

surprising, given that claims 1 and 29 are each directed to a novel way of performing vector quantization in a Noise Feedback Coding (NFC) system and Marcellin teaches away from the use of vector quantization.

In fact, beyond showing a Noise Feedback Coding structure in which a prediction residual is derived, Marcellin bears virtually no relation to the inventions recited in independent claims 1 and 29. Mere statements by the Examiner that Marcellin teaches various elements of claims 1 and 29, without any underlying support from that reference itself, cannot support a prima facie showing of obviousness. In the Amendment and Reply filed September 14, 2004, Applicant pointed out numerous incorrect assertions made by the Examiner regarding what Marcellin discloses. These points made by Applicant were neither acknowledged nor addressed by the Examiner in the subsequently-issued final Office Action. Because the Examiner's rejection of claims 1 and 29 are based on these assertions, the failure of any one of them is sufficient to overcome the Examiner's rejection of claims 1 and 29. These incorrect assertions are addressed in more detail herein:

(1) The Examiner asserts that Figure 1 of Marcellin discloses a method of efficiently searching N predetermined Vector Quantization (VQ) codevectors for a preferred one of the N VQ codevectors to be used in coding a speech or audio signal.

See Final Office action at page 7. This assertion is incorrect. Figure 1 of Marcellin shows a Noise Feedback Coding Structure that includes a block Q that Marcellin describes as a scalar quantizer (*see* Marcellin at p. 49, first paragraph) and that Marcellin teaches can be replaced by a Trellis Coded Quantizer (*see* Marcellin, p. 49, fourth paragraph). As noted above, Marcellin actually teaches away from the use of vector

quantization, and is silent as to any particular method for implementing vector quantization.

(2) The Examiner asserts that deriving a response error vector common to each of the N VQ codevectors is taught at page 48, paragraph 3 through page 49, paragraph 2 of Marcellin. See Final Office Action at page 7. These paragraphs describe an error sequence which is defined as the difference between a sampled speech input-sequence and a coded speech output-sequence ($s_i - \hat{s}_i$) associated with the Noise Feedback Coding Structure of Marcellin's Figure 1. These paragraphs also describe a quantization error sequence qi , associated with that coding structure. However, neither of these sequences are described as vectors, and neither of these sequences are described as being common to N VQ codevectors.

(3) The Examiner asserts that deriving N response error vectors each based on a corresponding one of the N VQ codevectors is taught at page 50, paragraphs 1-2 of Marcellin. See Final Office Action at page 7. Contrary to this assertion, the cited text simply discusses performing TCQ on a data sequence and appears to have nothing to do with deriving vectors of any kind.

(4) The Examiner asserts that selecting the preferred one of the N VQ codevectors as the VQ output vector corresponding to the residual signal based on the response error vector and the N response error vectors is taught at page 50, paragraph 2, through page 51, paragraph 1 and equation 10 of Marcellin. See Final Office Action at page 7. Contrary to this assertion, the cited text further describes performing TCQ on a data sequence and appears to have nothing to do with the selection of a preferred codevector.

The Examiner does concede that Marcellin fails to teach or suggest deriving "a ZERO-INPUT response error vector common to each of the N VQ codevectors" and deriving "N ZERO-STATE response error vectors each based on a corresponding one of the N VQ codevectors" as recited in claims 1 and 29. *See* Final Office Action at page 7 ("Marcellin et al. do not disclose language that explicitly deals with ZERO-INPUT or ZERO-STATE Response VQ Codevectors"). The Examiner states that these elements are taught by Watts. As previously argued by Applicant, although Watts does describe calculating a "zero input response" and "zero state response" of a filter to select a codevector for the purposes of performing vector quantization, it does not teach deriving "a ZERO-INPUT response *error vector* common to each of the N VQ codevectors" or deriving "N ZERO-STATE response *error vectors* each based on a corresponding one of the N VQ codevectors" as recited in claims 1 and 29.

As explained in the specification of the present application, an embodiment of the present invention decomposes a quantization error vector into a zero-input response error vector and zero-state response error vector:

A computationally more efficient codebook search method according to the present invention is based on the observation that the feedback structure in FIG. 13C, for example, can be regarded as a linear system with the VQ codevector out of scaled VQ codebook 5028a as its input signal, and ***the quantization error $q(n)$ as its output signal. The output vector of such a linear system can be decomposed into two components: a ZERO-INPUT response vector $q_{zi}(n)$ and a ZERO-STATE response vector $q_{zs}(n)$.*** The ZERO-INPUT response vector $q_{zi}(n)$ is the output vector of the linear system when its input vector is set to zero. The ZERO-STATE response vector $q_{zs}(n)$ is the output vector of the linear system when its internal states (filter memories) are set to zero (but the input vector is not set to zero).

See Specification at paragraph [0227]. Watts does not anywhere teach or suggest decomposing a vector representing quantization error (or any type of error for that

matter) to derive a zero-input response error vector and zero-state response error vectors as claimed. Rather, Watts teaches decomposing vectors representing predicted speech \hat{x}_n and reconstructed speech y_n into zero-input response and zero-state response components as illustrated by Watt's equations (6)-(9). This difference between Watts and the invention of claims 1 and 29 is due in part to the structure of Watt's speech coder, which is depicted in Figure 1(b) of Watts.

In the Final Office Action, the Examiner states that the zero-input response and zero-state response vectors derived in Watts are "error vectors" as recited in claims 1 and 29 because they are used to calculate a reconstruction error. *See* Final Office Action at page 3. In order to address this, Applicant has amended claims 1 and 29 to explicitly recite that the claimed ZERO-INPUT response error vector is "a component of a quantization error vector" and that each of the claimed N ZERO-STATE response error vectors is "a component of a quantization error vector."

Since neither Marcellin nor Watts, alone or in combination, teach or suggest each and every feature of independent claims 1 or 29, the combination of Marcellin and Watts fail to support a prima facie obviousness rejection of those claims. Also as noted above, one of ordinary skill in the art at the time of the invention would not have been motivated to combine these references. Accordingly, the Examiner's rejections of claims 1 and 29 under 35 U.S.C. § 103(a) are traversed and Applicant respectfully request that the rejections be reconsidered and withdrawn. Dependent claims 2-10, 12, 13, 15-17, 18, 29-38, 40-43, 45 and 47 are also not rendered obvious by this combination for at least the same reasons as independent claims 1 and 29 from which they depend and further in view of their own respective features. Accordingly, the Examiner's rejections of claims

2-10, 12, 13, 15, 16, 18, 29-38, 40-43, 45 and 47 under 35 U.S.C. § 103(a) are likewise traversed and Applicant respectfully request that these rejections be reconsidered and withdrawn.

Rejection of Independent Claim 20

Independent claim 20 is directed to a novel method of deriving a final set of codevectors for use in vector quantization. In particular, claim 20 recites a method of deriving a final set of N codevectors useable for prediction residual quantization of a speech or audio signal in a Noise Feedback Coding (NFC) system. The method of claim 20 includes the steps of:

- (a) deriving a sequence of residual signals corresponding to a sequence of input speech training signals;
- (b) quantizing each of the residual signals into a corresponding preferred codevector selected from an initial set of N codevectors to minimize a quantization error associated with the preferred codevector, thereby producing a sequence of preferred codevectors corresponding to the sequence of residual signals;
- (c) deriving a total quantization error energy for one of the N codevectors based on the quantization error associated with each occurrence of the one of the N codevectors in the sequence of preferred codevectors; and
- (d) updating the one of the N codevectors to minimize the total quantization error energy.

The Examiner has rejected independent claim 20 as obvious based on the combination of Marcellin and Watts. For reasons set forth above in regard to claims 1 and 29, one of ordinary skill in the art at the time of the invention would not have been motivated to combine these references. Furthermore, as will be described in more detail below, the combination of Marcellin and Watts fails to teach or suggest all of the elements of claim 20.

As discussed above, Marcellin teaches an NFC structure that uses Trellis Coded Quantization (TCQ) rather than vector quantization. Consequently, Marcellin does not teach or suggest "a novel method of deriving a final set of N codevectors useable for prediction residual quantization of a speech or audio signal in a Noise Feedback Coding (NFC) system" as recited in claim 20. Since the structure in Marcellin uses TCQ rather than vector quantization, there is simply no need to derive a final set of codevectors usable for vector quantization in Marcellin.

Despite this fact, the Examiner has asserted that every element of claim 20 is found in Marcellin². However, mere statements by the Examiner that Marcellin teaches the elements of claim 20, without any underlying support from that reference itself, cannot support a prima facie showing of obviousness. Because the Examiner's rejection of claim 20 is based on these assertions, the failure of any one of them is sufficient to overcome the Examiner's rejection of that claim. These incorrect assertions are addressed in more detail herein:

(1) The Examiner asserts that Figure 1 of Marcellin discloses a method of deriving a final set of N codevectors useable for prediction residual quantization of a speech or audio signal in a Noise Feedback Coding (NFC) system. See Final Office Action at page 12. This is an incorrect assertion. Figure 1 of Marcellin shows a Noise Feedback Coding Structure that includes a block Q that Marcellin describes as a scalar quantizer (*see* Marcellin at p. 49, first paragraph) and that Marcellin teaches can be replaced by a Trellis Coded Quantizer (*see* Marcellin, p. 49, fourth paragraph). As noted

² It is unclear to Applicant why the Examiner did not cite Marcellin as an anticipatory reference against claim 20 since he asserts that Marcellin teaches every element of that claim.

above, Marcellin actually teaches away from the use of vector quantization, and is silent as to any particular method for deriving codevectors.

(2) The Examiner asserts that deriving a sequence of residual signals corresponding to a sequence of input speech training signals is taught at page 48, paragraph 3 of Marcellin. See Final Office Action at page 12. The cited text describes Marcellin's noise feedback coding structure but is absolutely silent concerning deriving a sequence of residual signals "corresponding to a sequence of input speech training signals".

(3) The Examiner asserts that quantizing each of the residual signal into a corresponding preferred codevector selected from an initial set of N codevectors to minimize a quantization error associated with the preferred codevector, thereby producing a sequence of preferred codevectors corresponding to the sequence of residual signals is taught at page 48, paragraph 3 through page 49, paragraph 2 of Marcellin. See Final Office Action at page 12. The cited text describes Marcellin's noise feedback coding structure and aspects of its noise shaping capabilities, but is absolutely silent concerning quantizing residual signals into preferred codevectors or producing a sequence of preferred codevectors.

(4) The Examiner asserts that deriving a total quantization error energy for one of the N codevectors based on the quantization error associated with each occurrence of the one of the N codevectors in the sequence of preferred codevectors is taught at page 49, paragraph 1 of Marcellin. The cited text discusses noise shaping properties of Marcellin's noise feedback structure but is absolutely silent concerning deriving a total quantization error energy for a codevector.

(5) The Examiner asserts that updating the one of the N codevectors to minimize the total quantization error energy is taught by Figure 1 of Marcellin. As noted above, Figure 1 of Marcellin shows an NFC Structure that includes a block Q that Marcellin describes as a scalar quantizer and that Marcellin advocates can be replaced by a Trellis Coded Quantizer. Marcellin actually teaches away from the use of vector quantization, and is silent as to any particular method for updating codevectors.

Watts does not remedy the previously-identified deficiencies of Marcellin with respect to claim 20. Although Watts teaches a speech coder that utilizes vector quantization, it does not teach or suggest the particular method of deriving a final set of codevectors set forth in claim 20. For example, Watts does not teach or suggest the step of "deriving a total quantization error energy for one of the N codevectors based on the **quantization error** associated with each occurrence of the one of the N codevectors in the sequence of preferred codevectors" as recited in claim 20, since Watts nowhere teaches or suggests deriving a quantization error. Rather, the only error dealt with in Watts is termed a "reconstruction error", which is defined as the difference between the original speech signal x_n and the reconstructed speech signal y_n . See Watts, p. 276.

In response to the Applicant's argument that Watts fails to teach or suggest the step of "deriving a total quantization error energy for one of the N codevectors based on the quantization error associated with each occurrence of the one of the N codevectors in the sequence of preferred codevectors", the Examiner has cryptically stated that "the limitations of claim 20 are fully taught with respect to the combination of Marcellin in view of Watts . . . wherein Marcellin teaches the method steps, while Watts recites the use of individual speech vectors as previously addressed in claims 1 and 29 of the non-

final office action (Page 5) and is obvious in combination with Marcellin for the reasons given with respect to those claims." *See* Final Office Action at page 4. This conclusory statement provides no additional information concerning the basis for the Examiner's rejection of claim 20 and finds no support in Marcellin or Watts.

Since neither Marcellin nor Watts, alone or in combination, teach or suggest each and every feature of independent claim 20, the combination of Marcellin and Watts fail to support a prima facie obviousness rejection of this claim. Accordingly, the Examiner's rejection of claim 20 under 35 U.S.C. § 103(a) is traversed and Applicant respectfully request that the rejections be reconsidered and withdrawn. Dependent claims 21-27 are also not rendered obvious by this combination for at least the same reasons as independent claim 20 from which they depend and further in view of their own respective features. Accordingly, the Examiner's rejections of claims 21-27 under 35 U.S.C. § 103(a) are likewise traversed and Applicant respectfully request that these rejections be reconsidered and withdrawn.

Claim Objections

The Examiner has objected to claims 11, 14, 17, 19, 28, 39, 44 and 46 as being dependent upon rejected base claims. For the reasons set forth above, the rejections of the base claims have been traversed. Accordingly, Applicant respectfully request that the objection to claims 11, 14, 17, 19, 39, 44 and 46 be reconsidered and withdrawn.

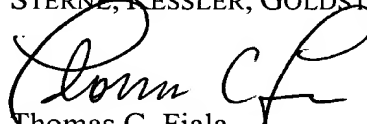
Conclusion

All of the stated grounds of objection and rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider all presently outstanding objections and rejections and that they be withdrawn. Applicant believes that a full and complete reply has been made to the outstanding Office Action and, as such, the present application is in condition for allowance. If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided.

Prompt and favorable consideration of this Amendment and Reply is respectfully requested.

Respectfully submitted,

STERNE, KESSLER, GOLDSTEIN & FOX P.L.L.C.



Thomas C. Fiala
Attorney for Applicants
Registration No. 43,610

Date: 5/13/05

1100 New York Avenue, N.W.
Washington, D.C. 20005-3934
(202) 371-2600